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Allelopathic Effect of Tropical Spiderwort (*Commelina benghalensis* L.) Powder on The Performance of African Eggplant (*Solanum macrocarpon* L.)

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Abstract

This project was carried out to investigate the allelopathic effect of *Commelina benghalensis* on the performance of *Solanum macrocarpon*. The experiment was carried out at Federal College of Agriculture, Moor Plantation, Ibadan (Latitude 7° 22'N, Longitude 3° 05'E). The whole plants of *Commelina benghalensis* was uprooted and washed in clear water, later air-dried to a constant weight and grinded to powdery form. The treatments were arranged in different dosages; 0 g (control), 20 g, 40 g, 60 g, 80 g and 100 g. The powdery *Commelina benghalensis* was broadcasted on each plot size 1 m by 1 m, mixed thoroughly and left for 2 days before the seeds of *Solanum macrocarpon* were planted, the experiments were laid out in randomized complete block design (RCBD). All data collected were subjected to analysis of variance (ANOVA) and significant treatment means were separated using Duncan multiple range test (DMRT) at 5% level of significance. Three plants were tagged to collect the following data: plant height (cm), stem girth (cm), number of leaves and yield (tons/ha). The results at 8 WAT showed that *Solanum macrocarpon* treated with 40 g of *Commelina benghalensis* had highest number of leaves (18.60) and yield (8.53 tons/ha). It can therefore be recommended that 40 g of powder *Commelina benghalensis* should be applied on *Solanum macrocarpon* plants to obtain good and better yield.

Keywords

Allelopathy, *Commelina benghalensis*, *Solanum macrocarpon*, Yield, Stimulatory

1. Introduction

Allelopathy can be defined as the inhibitory or stimulatory effect of a plant on the subsequent plant through the release of chemical compound into the environment and most allelochemicals are classified as secondary metabolites of the plant (Kruse *et al.*, 2000). Allelopathy is a form of positive and negative interaction among organisms that is caused by the action of chemical compounds referred to as allelochemicals (Rice, 1987) [1-2]. Growth cessation by allelopathic compounds covered all life stages from seeds (seed germination, seedling growth, leaf area) till matured plants as in dry matter production (Ei khatib *et al.*, 2004). In higher concentration of allelochemicals, seed germination and mitosis stopped (Peterson *et al.*, 2002). However, some weeds show allelopathic effects on agricultural crops by secreting allelochemicals that inhibit their growth and germination (Oudhia, 2000) [3-5].

Commelina benghalensis L. is native to tropical and sub-tropical regions in Africa, Asia and the Pacific.It is one of the world's worst weeds affecting 25 crops in 29 countries (Webster *et al.*, 2005). A key to *C. benghalensis* invasiveness is its reproductive flexibility. In its native geographical areas, that is, tropical Asia, Africa, and the Pacific Islands, *C.*

benghalensis grows as a perennial, but it can survive as an annual in temperate regions (Holm *et al.*, 1977). It is fast growing and a prolific seed producer (Walker and Evenson, 1985). Furthermore, *C. benghalensis* has the ability to regenerate from stem fragments (Budd *et al.*, 1979) and a high degree of tolerance to glyphosate (Culpepper *et al.*, 2004), make them exceptionally difficult to control in agronomic systems when it becomes established. However, there is urgent need to make use of this weed biomass in crop production; therefore, the objective of this study is to investigate allelopathic effect of *Commelina benghalensis* on the performance of *Solanum macrocarpon*.

2. Materials and Methods

The experiment was carried out at Federal College of Agriculture, Moor Plantation, Ibadan (Latitude 7°22' N and Longitude 3°05' E). Each plot was 1 m by 1 m and *Solanum macrocarpon* seeds were planted using spacing of 25 cm by 25 cm. Composite soil sample (0-20 cm) was collected, air dried at room temperature, crushed and made to pass through a 2 mm mesh sieve and subjected to routine analysis to determine the soil textural class and chemical analysis. The soil sample was carried out at the soil laboratory of Federal College of Agriculture, Ibadan

The experiment was laid out in Randomized Complete Block Design (RCBD), with six treatments; 20 g, 40 g, 60 g, 80 g, 100 g of powdery form of the whole plants of *Commelina benghalensis* and Control (0 g) replicated three times. The *Commelina benghalensis* powder of varying quantities was broadcasted on the soil, mixed thoroughly and left for (2) days before the seeds of *Solanum macrocarpon* were planted. Weeding was done weekly in order to reduce weed infestation and aqueous extract of neem leaves was applied every two days to control Leaf spot disease and Ladybird beetles insect. Three (3) plants were tagged to collect the following data: Plant height (cm) stem girth (cm), Leaf area (cm^2), number of leaves and Weight (tons/ha) of the vegetable. All data collected were subjected to analysis of variance (ANOVA) using SAS version 2009 and significant treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% level of significance.

3. Results

Table 1 showed that the soil used had a pH value of 6.40 which is slightly acidic, total Nitrogen 0.1 (g/kg), Organic carbon 0.1 (g/kg) which indicated that Organic carbon was extremely high in the soil and Available phosphorus 7.4 (g/kg), Calcium 0.3 (Cmol/kg), Magnesium 0.2 (Cmol/kg), Sodium 0.4 (Cmol/kg), Potassium 0.2 (Cmol/kg). The result showed that Potassium is extremely low in the soil. On particle size, the sand was 852 (g/kg), silt 68 (g/kg) and Clay 80(g/kg). Textural class is loamy sand.

Table 1. Physical and Chemical properties of the soil

Parameter	Value
pH	6.4
Available Phosphorous (mg/kg)	7.4
Organic Carbon (g/kg)	0.1
Organic Matter (g/kg)	0.2
Total Nitrogen (g/kg)	0.1
Exchangeable Bases (Cmol/kg)	
Ca	0.3
Mg	0.2
K	0.2
Na	0.4
Particle size (g/kg)	
Sand	852
Silt	68
Clay	80
Textural class	Loamy Sand

Table 2 showed phytochemical result of *Commelina benghalensis* powder. The powder had low content of all bioactive phytochemicals tested such as Alkaloid, Flavonoid, Phenolic, Saponin and Phytate. Alkaloid content (0.677±0.002)%, flavonoid content (0.0046±0.002)%, Phenolic content (0.427±0.001)%, Saponin content (0.141±0.001)% and Phytate (0.237±0.001)%.

Table 2. Quantitative phytochemicals result of *Commelina benghalensis* extract

Phytochemicals compounds	Composition (%)
Alkaloinds	0.679 ± 0.002
Flavonoids	0.0046 ± 0.002
Phenolic	0.427 ± 0.001
Saponin	0.141 ± 0.001
Phytate	0.237 ± 0.001

Results are means of duplicate determination ± standard deviation.

The effect of *Commelina bengalensis* powder on plant heights of *Solanum macrocapon* was presented in Table 3. At 2 WAT, control experiments had tallest plants (6.09 cm) which was significantly taller than plants treated with 20 g and 80 g powder of *Commelina bengalensis*. At 4 WAT, there were no significant differences among all treatments; although control experiments were the tallest (8.57 cm) while plants treated with 20 g powder of *Commelina bengalensis* were the shortest (7.34 cm). At 6 WAT, plants treated with 80 g powder of *Commelina bengalensis* had tallest plants (18.2 cm) which were significantly taller than treatments of 40 g and 60 g powder of *Commelina bengalensis*. At 8 WAT, plants treated with 100 g powder of *Commelina bengalensis* had tallest plants (25.51 cm) which was significantly taller than those treated with 60 g and 100 g, although there were no significantly differences among height of plants treated with 0 g, 20 g and 60 g.

Table 3. Effect of *Commelina bengalensis* powder on the plant height (cm) of *Solanum macrocapon* at 2, 4, 6 and 8 weeks after transplanting.

Treatment	2 WAT	4 WAT	6 WAT	8 WAT
T_1	6.09^{a}	8.57	13.38^{b}	21.80^{b}
T_2	4.80^{b}	7.34	13.31^{b}	21.83^{b}
T_3	5.04^{ab}	7.59	16.14^{ab}	22.66^{ab}
T_4	5.17^{ab}	7.73	15.38^{ab}	21.44^{b}
T_5	4.66^{b}	8.14	18.23^{a}	25.51a
T_6	5.11^{b}	7.97	16.25^{ab}	23.74^{a}

Means with the same letters in a column are not significantly different from one another at DMRT $p < 0.05$. WAT =Weeks after transplanting. Legends: T_1 = Control (0 g), T_2 = 20 g powder of *Commelina benghalensis*, T_3 = 40 g powder of *Commelina benghalensis*, T_4 = 60 g powder of *Commelina benghalensis*, T_5 = 80 g powder of *Commelina benghalensis*, T_6 = 100 g powder of *Commelina benghalensis*.

Effect of *Commelina benghalensis* powder on stem girths of *Solanum macrocapon* was presented in Table 4. At 2 WAT, there was no significant difference among all the treatments, although plants treated with 40 g powder of *Commelina bengalensis* had highest stem girth (1.53 cm) while plants treated with 20 g powder of *Commelina bengalensis* had lowest stem girth (1.34 cm). At 4 WAT, there were no significant differences among all the treatments, although plants treated with 60 g powder of *Commelina bengalensis* had highest mean stem girth (2.12 cm) while plants treated with 80 g powder of *Commelina benghalensis* had lowest mean stem girth (1.91 cm). At 6 WAT, there were no significant

differences among all treatments, although plants treated with 20 g powder of *Commelina bengalensis* had highest mean stem girth (3.45 cm) while plants treated with 80 g powder of *Commelina bengalensis* had lowest mean stem girth (3.01 cm). At 8 WAT, there were no significant differences among all the treatments, although plants treated with 60 g powder of *Commelina bengalensis* had highest mean stem girth (4.52 cm) while plants treated with 40 g powder of *Commelina bengalensis* had lowest mean stem girth (3.84 cm).

Effect of *Commelina benghalensis* powder on number of leaves of *Solanum macrocapon* was presented in Table 5. At 2 WAT, plants treated with 80 g powder of *Commelina bengalensis* had the highest mean number of leaves (7.91) while plants treated with 0 g and 100 g had least mean number of leaves each (6.33). At 4 WAT, plants treated with 40 g powder of *Commelina bengalensis* had highest mean number leaves (11.04) which was significantly higher than those treated with 0 g, 20 g and 100 g (8.50, 8.60 and 8.36, respectively). At 6 WAT, plants treated with 40 g powder of *Commelina bengalensis* had the highest mean number of leaves (14.28) and was significantly higher than all other treatments. At 8 WAT, plants treated with 40 g powder of *Commelina bengalensis* had highest mean number of leaves (18.60) which was significantly higher than treatments 0 g, 60 g and 100 g (14.56, 13.40 and 15.38, respectively).

Table 4. Effect of *Commelina bengalensis* powder on stem girth (cm) of *Solanum macrocapon* at 2, 4, 6 and 8 WAT.

Treatments	2 WAT	4 WAT	6 WAT	8 WAT
T_1	1.36	1.92	3.16	4.21
T_2	1.34	1.92	3.45	4.45
T_3	1.42	1.88	3.18	3.84
T_4	1.53	2.12	3.36	4.52
T_5	1.43	1.91	3.01	4.01
T_6	1.44	2.06	3.15	3.89

Means with the same letters in a column are not significantly different from one another at DMRT $p < 0.05$. WAT =Weeks after transplanting. Legends: T_1 = Control (0 g), T_2 = 20 g powder of *Commelina benghalensis*, T_3 = 40 g powder of *Commelina benghalensis*, T_4 = 60 g powder of *Commelina benghalensis*, T_5 = 80 g powder of *Commelina benghalensis*, T_6 = 100 g powder of *Commelina benghalensis*.

Table 5. Effect of *Commelina bengalensis* powder on the number of leaves of *Solanum macrocapon* at 2, 4, 6 and 8 WAT.

Treatments	2 WAT	4 WAT	6 WAT	8 WAT
T_1	6.33^{ab}	8.50^{b}	9.90^{c}	14.56^{c}
T_2	7.33^{a}	8.60^{b}	12.12^{b}	16.47ab
T_3	7.91^{a}	11.04^{a}	14.28^{a}	18.60^{a}
T_4	7.41^{a}	8.82^{ab}	10.15^{c}	13.40^{c}
T_5	7.58^{a}	9.50^{ab}	12.25^{b}	16.76^{ab}
T_6	6.33^{ab}	8.36^{b}	11.01^{bc}	15.38^{b}

Means with the same letters in a column are not significantly different from one another at DMRT $p < 0.05$. WAT =Weeks after transplanting. Legends: T_1 = Control (0 g), T_2 = 20 g powder of *Commelina benghalensis*, T_3 = 40 g powder of *Commelina benghalensis*, T_4 = 60 g powder of *Commelina benghalensis*, T_5 = 80 g powder of *Commelina benghalensis*, T_6 = 100 g powder of *Commelina benghalensis*.

The effect of *Commelina benghalensis* powder on yield of *Solanum macrocapon* was presented in Table 6. At 8 WAT, there were no significant differences among all the treatments though plants treated with 40 g powder of *Commelina bengalensis* had highest yield (8.53 tons/ha).

Table 6. Effect of different dosages of *Commelina benghalensis* powder on the yield (tons/ha) of *Solanum macrocapon*.

Treatments	Yield (tons/ha)
T_1	7.36
T_2	7.25
T_3	8.53
T_4	7.15
T_5	7.29
T_6	7.64

Means with the same letters in a column are not significantly different from one another at DMRT $p < 0.05$. WAT =Weeks after transplanting. Legends: T_1 = Control (0 g), T_2 = 20 g powder of *Commelina benghalensis*, T_3 = 40 g powder of *Commelina benghalensis*, T_4 = 60 g powder of *Commelina benghalensis*, T_5 = 80 g powder of *Commelina benghalensis*, T_6 = 100 g powder of *Commelina benghalensis*.

4. Discussion

The results of this work indicated that at lower dosage of 40 g of powder *Commelina benghalensis* stimulates the plant height, number of leaves and yield of *Solanum macrocarpon*. This is in line with Mvumi *et al.* (2012) who reported that moringa leaf extract increase growth and yield of tomato i.e spraying of moringa extract every 2 weeks from 2 weeks after transplanting gave the highest fresh fruit weight of 31.88 tons/ha [6-8]. Also, this work is in support of Mao *et al.* (2010) who reported that aqueous extracts of *Bidens pilosa* with low concentration of 20 mg/ml had some stimulatory effect on bud growth of *Trifolium repens* and *Medicago sativa* while high concentrations of 100 mg/ml had a considerable inhibitory effect on seed germination and seedling growth [9-13].

5. Conclusion

This study has shown that *Commelina benghalensis* powder have allelopathic effect on *Solanum macrocapon* plants. At 8 WAT, application of 40 g powder of *Commelina benghalensis* gave 8.53 tons/ha which was higher than all other treatments. This indicated that *Commelina benghalensis* powder had inhibitory type of effect on the *Solanum macrocapon* plants. It is also observed that higher dosage of *Commelina benghalensis* powder reduced performance of *Solanum macrocapon* plants.

Therefore, 40 g of *Commelina benghalensis* can be used on plot size 1 m by 1 m to stimulate the performance of *Solanum macrocapon* plants.

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